1.0 EXECUTIVE SUMMARY

This report assesses the acoustic effects that may be expected when the Platform Hazel caissons are broken apart with explosives following procedures described in Chapter 2 of the Environmental Impact Report (EIR). The report analyses the dynamics of the explosives, the caisson structures and the surrounding media through which sound pressure waves will travel. It then predicts the acoustic signature produced by the explosives.

The underwater geometry of this study is simplified because the acoustic source is relatively deep (96 feet below the surface), making tidal variations and sea state comparatively minor factors in acoustic propagation. Since the caisson is resting directly on the bedrock, there is no chance for a significant convergence zone appearing due to the interaction of the direct acoustic water wave and the pressure wave in the bottom material. The speed of sound in the shale bedrock is more than twice the speed of the water wave, so the bottom wave will quickly outrun the water wave.

Estimates were made of the expected peak acoustic energy and momentum at different ranges in different directions around the caissons when explosives will be used to break them up. The primary estimates are the sound pressure level (SPL), impulse (Imp) and sound energy level (SEL) at different distances from the caisson. A secondary, related, parameter is the pulse width of the shock wave associated with the detonations.

Calculations were performed for three directions about the caissons. The detonations will occur in a carefully chosen pattern within the concrete inside each caisson. The largest sound pressures will be observed directly in front of a “door” which will be cut in the exterior of the caisson to provide a free face, giving the concrete somewhere to go when the detonations break it up. Lower sound levels will be observed to the left, right and opposite that direction. This is because explosives tend to take the path of least resistance, which in this case is through the door. The steel walls of the caisson surrounding the door also help reduce sound levels in the other directions.

If unimpeded, sound pressure levels emitted through the door will not fall below levels accepted by the regulatory agencies as safe for marine life until a range of one kilometer is reached. To reduce sound pressure levels coming out of the door, Howorth (MMCG, pers. comm. 2002) suggested placing a thick berm of heterogeneous material in front of the door. This berm will reflect, absorb and diffract sound pressure levels so that the hazard zone will be reduced from one kilometer to 300 meters. The caisson, resting on bedrock, has had the shell mound material excavated in front of its door. The berm has been placed in front of the door. The berm is discussed in detail in Section 2.1.3.

Levels accepted by the regulatory agencies in various past projects include an SPL of 180 decibels referenced to one micropascal (180 dB re 1 µPa), an impulse of 12 pounds per square inch times millisecond (12 psi-ms) and an SEL of 182 dB re 1µPa^2-second. The ranges at which each of these levels occurs are determined from the propagation calculations.

The following tables summarize the ranges, in three directions, at which the three key parameters reach their threshold values. The first table is for the depth at which the detonations take place.

Table 1. Predicted range (meters) for key thresholds at 96 ft. depth

Quantity	*SPL*	*Impulse*	*SEL*
Threshold Unit	180 dB re 1 µPa	12 psi-ms	182 dB re 1 µPa^2-s
Front	230	133*	20*
Side	500	75	13
Back	300	75	11
* At depths above the geometric shadow cast by the berm on			

The next table summarizes the same information for 6 feet (1.8 meters) below the surface. If one moves closer to the surface than this, additional factors, such as sea state and entrained bubbles, make predictions of impulsive acoustic levels unreliable.

Table 2. Predicted range (meters) for key thresholds at 6 ft. depth

Quantity	*SPL*	*Impulse*	*SEL*
Threshold Unit	180 dB re 1 µPa	12 psi-ms	182 dB re 1 µPa^2-s
Range (front)	280	63	N/A*
Range (side)	500	71	N/A*
Range (back)	299	71	N/A*
*Threshold occurs below this depth.			

The significant differences in ranges at the same SPL in different directions show how sensitive the acoustic propagation process is to the details of the detonations and the caisson structure.

Impulse is a measure of momentum. SPL and pressure are measures of power. SEL is a measure of energy. Therefore, these quantities will change in different ways relative to each other with changes in the size of the explosive charge, or the distance from the site of the explosion.

This document presents the results of all these model calculations. The demolition procedures applied to this model were developed by professionals with expertise in the use of explosives for decommissioning projects. The specific procedures were designed to minimize potential impacts of explosives on marine life, while still effectively performing the demolition work. Effective application of the model predictions will depend upon the applicant's selection of contractors familiar with such procedures and upon the ability of such contractors to implement procedures described in this report and in the EIR. For interpretation of this model in terms of marine biological resources, please see the EIR.